Honors Physics Summer Packet

Dear Honors Physics Student:

The purpose of this assignment is to: 1) encourage you to reflect on how you learn and what it means to understand; 2) give you an overview of the course content and expectations; 3) review fundamentals including units, the metric system, and unit analysis; and 4) develop skills with LoggerPro™, the data collection and analysis software we will use throughout the year.

The table below lists things you need to do before September. Please complete #1 before classes end in June. Complete #2 through #9 over the summer so that you are ready to check the answer keys and ask questions when classes start in the fall. There will be a quiz covering the topics of this packet during the first or second week of school.

If you need help before summer break, try to catch me at school. During summer break, please post questions to the Edmodo group so that others will also benefit from the discussion. Please do not call Vernier Software and Technology™ with questions about the summer portfolio.

Here is a summary of the contents, and what you need to do with them.

Document or Task	What you need to do ....
1. Edmodo sign-up, pick up textbook	▪ Stop by 531 to sign up for the honors physics Edmodo group. I will give you the needed member code. Pick up a text at the same time.
2. Let's have a little chat..., an excerpt from *Physics for scientists and engineers*, by Randall Knight	▪ This is an excerpt from a popular university level textbook that introduces physics to incoming students. Please read it carefully, and think about what it means to you as a learner.
3. Syllabus and Expectations	▪ Read this carefully. Pay special attention to the section titled "Learning Physics", and to the attachments "Our goals as thinkers" and "Bloom's taxonomy of thinking skills". ▪ **Please sign, and return the last page when classes begin.**
4. LoggerPro™ Installation and Skill Building	▪ Install LoggerPro™ at home ▪ Complete the LoggerPro™ tutorials
5. Lab – Finding Relationships in Data 6. 1 cm grid paper 7. Lab – Working with Analytical Tools 8. Presenting Your Experimental Results	▪ Complete the labs. Use the 1 cm grid paper for the lab "Finding Relationships..." ▪ Present your experimental results using tables and graphs. Use "Presenting Your Experimental Results" as a guide.
9. Problem set – *The Metric System, Units and Significant Digits*	▪ Complete the problem set. Most of the questions should be topics that you covered in chemistry. Use your text as a reference. Answers to odd numbered problems are in the text. We will discuss any problems that give you trouble in September.

Sincerely,

Richard Levergood

Mr. Levergood

The most incomprehensible thing about the universe is that it is comprehensible.
—Albert Einstein

The day I went into physics class it was death.
—Sylvia Plath, *The Bell Jar*

From Knight, Randall D. Physics for Scientists and Engineers,a Strategic Approach. Pearson. 2013. p. xv.

Let's have a little chat before we start. A rather one-sided chat, admittedly, because you can't respond, but that's OK. I've talked with many of your fellow students over the years, so I have a pretty good idea of what's on your mind.

What's your reaction to taking physics? Fear and loathing? Uncertainty? Excitement? All of the above? Let's face it, physics has a bit of an image problem. You've probably heard that it's difficult, maybe downright impossible unless you're an Einstein. Things that you've heard, your experiences in other science courses, and many other factors all color your *expectations* about what this course is going to be like.

I think it's fair to say that it will be an *intense* course. But we can avoid many potential problems and difficulties if we can establish, here at the beginning, what this course is about and what is expected of you—and of me!

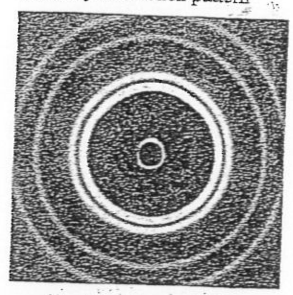
Just what is physics, anyway? Physics is a way of thinking about the physical aspects of nature. Physics is not better than art or biology or poetry or religion, which are also ways to think about nature; it's simply different. One of the things this course will emphasize is that physics is a human endeavor. The ideas presented in this book were not found in a cave or conveyed to us by aliens; they were discovered and developed by real people engaged in a struggle with real issues. I hope to convey to you something of the history and the process by which we have come to accept the principles that form the foundation of today's science and engineering.

You might be surprised to hear that physics is not about "facts." Oh, not that facts are unimportant, but physics is far more focused on discovering *relationships* that exist between facts and *patterns* that exist in nature than on learning facts for their own sake. As a consequence, there's not a lot of memorization when you study physics. Some—there are still definitions and equations to learn—but less than in many other courses. Our emphasis, instead, will be on thinking and reasoning. This is important to factor into your expectations for the course.

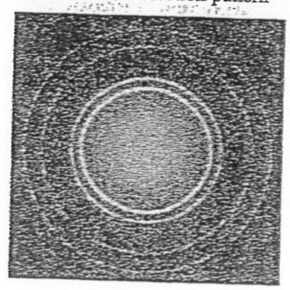
Perhaps most important of all, *physics is not math!* Physics is much broader. We're going to look for patterns and relationships in nature, develop the logic that relates different ideas, and search for the reasons *why* things happen as they do. In doing so, we're going to stress qualitative reasoning, pictorial and graphical reasoning, and reasoning by analogy. And yes, we will use math, but it's just one tool among many.

It will save you much frustration if you're aware of this physics–math distinction up front. Many of you, I know, want to find a formula and plug numbers into it—that is, to do a math problem. We'll certainly do many calculations, but the specific numbers are usually the last and least important step in the analysis.

(a) X-ray diffraction pattern



(b) Electron diffraction pattern



Physics is about recognizing patterns. For example, the top photograph is an x-ray diffraction pattern showing how a focused beam of x rays spreads out after passing through a crystal. The bottom photograph shows what happens when a focused beam of electrons is shot through the same crystal. What does the obvious similarity in these two photographs tell us about the nature of light and the nature of matter?

As you study, you'll sometimes be baffled, puzzled, and confused. That's perfectly normal and to be expected. Making mistakes is OK too *if* you're willing to learn from the experience. No one is born knowing how to do physics any more than he or she is born knowing how to play the piano or shoot basketballs. The ability to do physics comes from practice, repetition, and struggling with the ideas until you "own" them and can apply them yourself in new situations. There's no way to make learning effortless, at least for anything worth learning, so expect to have some difficult moments ahead. But also expect to have some moments of excitement at the joy of discovery. There will be instants at which the pieces suddenly click into place and you *know* that you understand a powerful idea. There will be times when you'll surprise yourself by successfully working a difficult problem that you didn't think you could solve. My hope, as an author, is that the excitement and sense of adventure will far outweigh the difficulties and frustrations.

Course Syllabus
Honors Physics

Contact Information

Instructor: Mr. Levergood, Room 531, rlevergood@londonderry.org

Welcome to Physics!

Physics is an empirical science that seeks understanding of how nature works. Others have described physics more eloquently:

> *Physicists' interests range from the tiny world of subatomic particles to stars, galaxies and the vast cosmic sea of space and time in which they travel. They have developed intricate tools to assist the human senses in probing these remote extremes of our natural environment. They have distilled their understanding of nature into laws of great generality and elegance, from the mathematical patterns needed to interpret the perfect symmetry and the regularity of atoms and crystals, to the powerful mathematical treatment of chaos and disorder needed to deal with the concept of heat. [http://www.wpi.edu/academics/Depts/Physics/]*
>
> *Physics is the most fundamental and all-inclusive of the sciences, and has had a profound effect on all scientific development. In fact, physics is the present–day equivalent of what was once called natural philosophy, from which most of our modern sciences arose. [Richard Feynman, Six Easy Pieces]*

Physics is NOT just about math, just as American literature is not just about spelling or grammar. However, mathematics is the language of physics- it helps us communicate what we observe, it deepens our understanding of nature, and it allows us to make predictions.

General Course Objectives

You will be introduced to fundamental principles of mechanics and electricity. General goals are to:

1. Become proficient in the use of metric and Imperial units, vectors, and graphical tools;
2. Use systems of equations and algebraic manipulations to gain insight into natural phenomena;
3. Develop good problem solving and problem presentation skills;
4. Participate in open-ended and collaborative lab investigations using scientific inquiry;
5. Carefully perform laboratory activities with appropriate attention to safety;
6. Take accurate experimental measurements, organize and interpret data, and draw reasonable conclusions from the data while following a scientific process;
7. Understand that the mathematics of physics describes the behavior of the physical world, then apply mathematical skills to analyze physical situations, and understand the physical significance of the variables;
8. Consider measurement uncertainty when interpreting experimental data;
9. Use dimensional analysis and common sense to check the validity of calculated results.

Learning Physics

Learning physics <u>is not</u> a spectator sport or a memory-based endeavor. Physics <u>is</u> a thinking endeavor. You must be actively engaged in all aspects of the class if you want to do well. You must learn to synthesize concrete and abstract concepts, find associations, make connections to phenomena you observe, and formulate mental models of the way nature behaves. Learning physics involves both understanding concepts, and solving quantitative problems. The two processes are inseparable and support each other. To get a better grasp on these goals, read the attached "Our Goals as Thinkers" and "Bloom's Taxonomy of Thinking Skills".

These are not easy tasks for most introductory students. Following are some tips that will help you succeed:

1. Be prepared for class by reading handouts, the text and assigned problems.
2. Use the text to improve your understanding and clear up things you don't "get"
3. Ask questions (smart people ask questions) and participate in discussions.
4. Do not miss class if you can avoid it. Get notes and catch up quickly if you do.
5. Think. Stay engaged. Do not memorize but seek understanding.
6. Review and practice the math as needed.
7. Make connections between physics concepts, laws, theories, lab work and problem solving activities.
8. Know how to use your calculator. Bring it to class every day.
9. Stay in touch, let me know how you are doing. Do not slip under my radar.
10. Do not work alone. Form a study group. Support and instruct each other.
11. This is not a plug-and-chug equation class. It is about understanding, and you should approach problem solving with that in mind.
12. Understand problems before you start plugging in numbers. Follow a problem solving procedure. Do not expect all problems to be straightforward. Wrong turns and dead ends are often instructive.
13. Do the exercises without peeking at the answer. Then peek at the answer and correct your work as needed.
14. Visualize. Sketch diagrams, cartoons, graphs, or whatever helps. Include "self-explanation" notes in your work.
15. Pay close attention to units and signs.
16. Check the results of your calculations to see if they are reasonable.
17. Get help when needed – but try it yourself first.
18. Practice, practice, practice. Humans are not born with good problem solving skills - they must be developed. It is like sports – listening to your coach but skipping practices will not make you a better player.
19. Do not attempt to memorize. Instead, seek a deep and rich understanding of the concepts.
20. Learn by doing in labs. Take your time and make connections between the math, abstract concepts, your experimental observations, and your experience in "the world".
21. Reject the idea that you can solve physics problems by following "cookbook" like instructions. <u>There is no cookbook</u>. You must learn to think and apply fundamental concepts, like when playing jazz!

Expectations

I expect you to be inquisitive, have a strong interest in science, possess good math skills, to be self-motivated and hard-working, and have an open-minded and reflective attitude about learning. I also expect that you will demonstrate initiative, honesty, effort, respect to others and their ideas, and a collaborative professional spirit.

Remember that this is an elective upper-level science class and you are now seniors. You chose to be here.

Course Information

Textbook	Wilson, Jerry D., A. J. Buffa, and B. Lou. *College Physics*, 6 ed., Prentice Hall. 2007. This is an algebra based college level text. Selected sections will be assigned for reading.
Prerequisites	You will need a strong background in algebra and trigonometry. You should have successfully completed Algebra II. Calculus skills are not required, but will be helpful.
Attendance	Excellent attendance in this class is very important - an absence often means missing a critical lesson or lab. This will become an issue for some of you as absences for college visits and other senior activities accumulate. Attendance issues are often the cause of students falling behind, being unprepared, and bombing exams. Although I strongly support your many non-physics activities, I do not slow down or change the class schedule to accommodate any individual student. If you are absent and do not know what you missed, you should consult with a friend, or see me. Remember that you are responsible for all information presented in class whether you are here or not. All absences and tardies will be handled in accordance with school policy.
Computers and Calculators	You will need a scientific type calculator such as a TI-30 or HP35s. A graphing type calculator such as the TI-83$^+$ or TI-84$^+$ will be very helpful. Come to class with your own calculator. I will not loan you a calculator. You may not share a calculator during tests or quizzes. You should have a computer at home on which you can install LoggerPro™ data analysis software. If you do not, you will need to get familiar with using those in the classroom or library. I expect you to use all classroom computers responsibly and abide by the LHS Acceptable Use Policy.
Cell Phones	At this time, I do not intend to allow use of cell phones in class. Please leave it in your backpack or bag. I might change my mid later.
Extra help	If you need extra help you should attend a scheduled help session which will be announced at the beginning of the school year. In cases where that is not possible, you may make an appointment to meet with me at some other time. When you come for help, have specific questions in mind or come prepared to ask about specific topics. If you simply tell me "I don't understand anything about this topic" then I will assume you haven't done much thinking on your own. If you schedule a future time with me be sure to post an appointment slip on the appointment board to help me remember.
Homework	Homework will include *worksheets* and *problem sets*. Worksheets have a narrow focus; problem sets include more comprehensive problems. In both cases you will be given the final answers – you should focus on how to get there! We will dedicate many class days to discussing homework and problem solving in general. You must complete the work in advance in order to ask thoughtful questions. Exams and quizzes will often include questions taken from the homework, so it is in your best interest as an active learner (and for your GPA) to do all of the assigned homework. <u>Homework will not be graded, but will be discussed in class</u>.
Running Start Program	This course meets the requirements of Manchester Community College's (MCC) College Physics I (4 credits) and is offered through MCC's Running Start Program. Students enrolled in the Running Start program must abide by the Manchester Community College Departmental Policies included on the last page of this syllabus.

Graded Work

Graded work will include **Labs**, **Exams**, **Quizzes**, and **Competency Exams**.

Labs are generally data intensive experiments that require setting up equipment, careful observations and measurements, graphing, curve fitting, and evaluation of mathematical models. You should repeat your lab work until it is satisfactory. I will be happy to comment on your lab worksheets before you call them "complete".

- *A Lab Worksheet* must be completed by every student, but you submit only one worksheet per group for a group. Your lab grade will include group and individual participation components according to the Lab Grade Rubric.
- No lab work will be accepted after the unit exam.

An **Exam** will be given for each unit.

- Each exam will focus on material covered since the last test, but will require understanding of many previous topics.
- Exams will be closed notes and closed book, but you may use the equation reference provided with each unit outline. You may also use your physics t-shirt and a 8 ½ x 11 handwritten cheat sheet prepared by yourself.
- Exams may include conceptual understanding questions (multiple choice and short answer), diagram and graph interpretation, word problems that require calculations, questions about labs, worksheets, and assigned reading from the text. Exams will test your critical thinking ability and conceptual understanding, not your ability to memorize and repeat what I have already told you. Consequently, you will see questions not posed to you in class or in homework.
- If you do poorly on an exam, you may take a *second chance exam* for a maximum possible grade of 70%, after completing substantial remedial work.

Quizzes will be given frequently. There are two kinds of quizzes. *Homework quizzes* will be a randomly selected homework problem, although the given values and the solved variable could be different. You can refer to your problem set when taking a homework quiz. A *Quiz* could ask any question(s). I will tell you if you are permitted to refer to notes, the textbook, or your completed homework while taking the quiz.

Competency Assessments will be administered at the end of selected units as listed on the Schedule of Topics.

Grading

Quarter and semester grades at will be based on weight total points earned, weighted 60% exams, 20% quizzes , and 20% labs.

Your LHS quarter and semester grade letter grades will be assigned in accordance with LHS policy. Students enrolled in College Physics at Manchester Community College (MCC) will also receive a grade based on the scale shown on the right.

MCC Grade Scale			
Letter	**Numeric**	**Letter**	**Numeric**
A	93.33 - 100	C+	76.67 - 79.99
A-	90.00 - 93.32	C-	70.00 - 73.32
B+	86.67 - 89.99	D+	66.67 - 69.99
B	83.33 - 86.66	D	63.33 - 66.66
B-	80.00 - 83.32	D-	60.00 - 63.32
C	73.33 - 76.66	F	Below 60

I generally do not offer extra credit. The only exception is for projects of exceptional educational value that are motivated by learning, not just grades. You will have plenty of other opportunities to improve your grade. It is better to put your effort into doing a good job on the assigned work.

If I make a grading mistake, tell me promptly and I will fix it. If you disagree with a grade, you receive then see me and make your case on the merits of your own work and knowledge of physics. Leave other students out of it.

<table>
<tr><td rowspan="8">Makeup Policy</td><td colspan="2">I am generally flexible, and will often make exceptions to accommodate students with significant family, personal, or academic issues. It is best to see me regarding any issues early rather than late.</td></tr>
<tr><td>• You are absent (excused) on an exam day.</td><td>Take the exam at the next makeup session (see below). This may be the day of your return!</td></tr>
<tr><td>• You are present on an exam day but absent the day before.</td><td>You take the exam anyway.</td></tr>
<tr><td>• You are present on an exam day but absent (excused) for 2 or more days immediately prior to an exam.</td><td>You may take a makeup exam at the next makeup session (see below).</td></tr>
<tr><td>• You miss an entire lab</td><td>You must make it up outside of class during makeup sessions (see below).</td></tr>
<tr><td>• You miss part of a lab, on any day for any reason</td><td>We will deal with this on a case-by-case basis.</td></tr>
<tr><td>• Any unexcused absence</td><td>You get a zero for any missed graded work.</td></tr>
<tr><td colspan="2">Makeup sessions will be held:
• On scheduled days and times that will be announced at the beginning of the school year; and
• by appointment if necessary due to extraordinary circumstances.
A grade penalty of 10% may be applied if you fail to show up for a makeup. Makeup exams will cover the same general topics as the regular exam, but may be very different in format, or the number and type of questions. Second chance exams will not be available to you if you take a makeup exam.</td></tr>
<tr><td>Honor Policy</td><td colspan="2">You are expected to abide by the school honor policy as well as the one I will hand out in class.</td></tr>
</table>

<u>Manchester Community College Departmental Policies</u>

Academic Adjustments/Disabilities Services: Please be advised that students currently receiving modifications in an IEP under the Individuals with Disabilities Education Act and Section 504 of the Rehabilitation Act will not be eligible for modifications in a college course in the Running Start Program. While students may be eligible for accommodations through the college's Disabilities Services Office, students must be otherwise qualified to do college level work and address the essential elements of the course without fundamental alterations to the curriculum. If you have questions, please contact the Disabilities Coordinator at the college offering the course in the Running Start Program.

Tuition Refund Policy: the college cannot issue Refunds of the Running Start course tuition. This is a CCSNH (Community College System of NH) policy for the Running Start program.

Drop Policy: Simply ceasing to attend classes or notifying the instructor does not constitute officially dropping a course. If you plan to drop the college course, you must complete an official college Drop Form that is available from the Manchester Community College website. The student can go to <u>www.mccnh.edu</u> then click on Academics and then, Forms to Download. The Drop Form must be signed by the instructor and the Running Start student, and then forwarded to the Running Start Coordinator at least 6 weeks before the end of the course.

CAPS: The Center for Academic Placement and Support (Room 216) offers a variety of academic support services including peer and professional tutoring to Manchester Community College students. There is no charge to students for these services.

Academic Integrity: While students are encouraged to collaborate and discuss physics outside the classroom, each student is required to do and submit his/her own work. If cheating is suspected, ALL STUDENTS INVOLVED may receive a grade of zero on that assignment, quiz, or exam, at the instructor's discretion. The instructor has a ZERO TOLERANCE policy regarding dishonesty/cheating/and plagiarism as outlined in the *MCC student handbook,* which can be found online at: <u>http://www.mccnh.edu/pdf/StudentHandbook.pdf</u>;

Schedule of Topics

This following schedule is ambitious, and will be modified as needed throughout the year. Corresponding Next Generation Science Standrards (NGSS) are listed for each unit.

Week	Unit Title and Topics Covered
S1 1-3	**Introduction to physics and physics skills:** This unit includes a course overview, brief review of summer packet, mass, weight, inertia, frames of reference, conducting experiments, Fermi estimates, problem solving, regression analysis, systems of units, and interpreting measurements in experiments. HS-ETS1-2
S1 4-7	**Kinematics in one dimension** ***[Competency Assessment]:*** Kinematics is the descriptive study of motion. We will study mathematical and graphical analysis of position, displacement, speed, velocity, and acceleration; free falls, weightlessness, 1D vectors, computational methods, and modeling motion with the programming language VPython. HS-ESS1-2
S1 8-11	**Forces and motion** ***[Competency Assessment]:*** We will extend kinematics by exploring forces - interactions that change how things move. Topics include types of forces, force vectors, Newton's laws, "weightlessness", classical views of friction, drag, multi-body problems, inclined plane problems, banked curves, vertical loops, numerical modeling of falls that include drag, and Newton's Law of Gravitation. HS-PS2-1, HS-PS2-3, HS-PS2-4, HS-ETS1-3, HS-ETS1-2, HS-ETS1-4, HS-ESS1-3, HS-ESS1-4.
S1 12-13	**Kinematics in two dimensions:** This unit extends the study of kinematics with 2D vectors and examination of the motion of projectiles, with and without drag. We will also do a few problems in 3D. HS-ETS1-2, HS-ETS1-3, HS-ETS1-4
S1 14-17	**A modern approach to work and energy [Competency Assessment]:** This unit starts by defining energy conceptually, and from the modern perspective of Einstein's theory of special relativity. We will address reference frames, the speed of light, the principles of relativity, relativistic velocity addition, time dilation and length contraction, energy considerations in particle decay, and changes in particle identity. We will then move on to classical views of energy, energy transfers and transformations, the energy principle (first law of thermodynamics), work by constant and variable forces, heat and thermal energy, power and efficiency. HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3-4
S1 18	**Review, mid-year exams**
S2 1-3	**Static Electricity:** electric charge, methods of charging, conductors and insulators, electric force, Coulomb's law, applications, electric fields, electrical energy and electric potential, voltage, charge sharing, capacitors. HS-PS2-4, HS-PS3-2, HS-PS3-5
S2 4-6	**Current Electricity and Circuits [Competency Assessment]:** current, current, energy transfer, resistance, Ohm's law, Kirchoff's Laws, circuit measurements, circuit schematics, commercial energy transmission, household applications HS-PS2-5, HS-PS4-2, HS-ETS1-3
S2 7-9	**Linear momentum and collisions** ***[Competency Assessment]:*** The concept of momentum is closely related to forces and Newton's Laws. This unit explores linear momentum in 1-D and 2-D, impulse, conservation of momentum, and propulsion. HS-PS2-2, HS-PS2-3.
S2 10-12	**Waves and Sound (time permitting)** ***[Competency Assessment]:*** wave properties and motion, standing waves, resonance, interference, speed of sound, Doppler effect, sound from musical instruments, music and musical instruments. HS-PS4-1, HS-PS4-3.
S2 13-14	**Rotational motion (time permitting):** Motion is not always strictly translational! This unit covers angular measurements, angular speed and velocity, period and frequency, uniform circular motion, centripetal acceleration, centripetal and centrifugal force, applying Newton's Law of Gravitation to circular motion, torque, equilibrium, center of mass, and rotational inertia.
S2 15-17	**Final Project:**
18	**Senior week**

Our Goals as Thinkers[1]

A Novice		An Expert
Focus on formulas and plug-n-chug	*Knowledge content*	Focus on concepts and problem solving process
Unrelated pieces	*Knowledge structure*	Coherence
Guided by authority	*Thinking process*	Guided by experiment & reasoning
Drudgery, disappointment, discouragement	*Personal satisfaction*	Joy, fulfillment, inspiration

Science education moves you this way.......... →

[1] Adapted from Hammer, David.Cognition and instruction. 1999.

Bloom's Taxonomy[2] of Thinking Skills

	Skill	Keywords	Example
Higher-order thinking	**VI. Creating** Combine ideas or other relationships that result in a new idea or product; the ability to put parts together to form a new whole	Design Develop Construct Plan Produce Invent Devise Make Synthesize Create	• Design a clothoid loop for an amusement park roller coaster. Assume the total mass of a car and the riders is 1500 kg. The car enters the bottom of the loop at 20 m/s. Design the loop so that the riders experience 0.5 g's when upside down at the top of the loop, and no more than 3 g's at any other position.
Higher-order thinking	**V. Evaluating** Judging the value of ideas, materials and methods by developing and applying standards or criteria	Check Critique Judge Test Detect Monitor Evaluate Compare	• A 1500 kg car travels at 90 km/hr along a straight and level concrete highway. Seeing a pedestrian on the road 100 m ahead, the driver slams on the brakes and skids to a stop. The reaction time of the driver is 150 ms. What is the minimum coefficient of friction required to stop the car before hitting the pedestrian? Using standard values, does the driver avoid hitting the pedestrian if: -the road is dry? -the road is wet? -the car has antilock brakes? • Justify the use of classical mechanics rather than special relativity to solve the above problem.
Higher-order thinking	**IV. Analyzing** Breaking information down into its component elements	Analyze Organize Attribute Outline Structure Integrate Synthesize	• A 1000 kg car is pushed with a force of 1000 N. Calculate it's displacement after 10 seconds, given that the initial speed of the car was 10 m/s. • A blue car and a red car are pushed with forces of 1000 N and 1200 N, respectively. The blue car accelerates at 3 m/s^2 and the red car accelerates at 5 m/s^2. Compare the weights of the two cars.
Lower-order thinking	**III. Applying** The ability to use learned material in a new situation; apply rules laws, methods, and theories	Implement Use Execute Perform Compute Calculate	• A 10,000 kg spacecraft, in deep space far from any gravitational force, accelerates at 1.5 m/s^2. Calculate the magnitude of the applied force. Explain how it is possible to apply a force if there is no atmosphere for the rocket engine to push against.
Lower-order thinking	**II. Understanding** Grasping the meaning of material	Interpret Summarize Paraphrase Explain	• In your own words but using correct physics terminology, explain the meaning of Newton's second law. Include an explanation of each physical quantity.
Lower-order thinking	**I. Remembering** Remembering previously learned material; recall facts or whole theories	State List Identify Name Locate Find	• Write the expression for Newton's second law. • List the three physical quantities in Newton's second law. • Name the country was Isaac Newton born? • Identify the variable that represents acceleration

[2] Adapted from L. W. Anderson, D. R. Krathwohl, Peter W. Airasian, Kathleen A. Cruikshank, Richard E. Mayer, Paul R. Pintrich, James Raths, and Merlin C. Wittrock (eds) (2000) *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*. Allyn and Bacon.

AGREEMENT

Honors Physics Expectations

I thoroughly read the expectations for Honors physics, and I understand the meaning. I know that I will be held accountable for meeting these expectations, and that failure to do so could affect my grade. I discussed the expectations with my parent(s)/guardian, and we agree that this is an appropriate class for me.

____________________	____________________	__________
student Signature	student email	date
parent/guardian signature	parent email	date

LoggerPro™ Installation and Skill Building

We will use Logger Pro™ software to collect and analyze experimental data throughout the school year so it is very important that you become proficient with its use. If you intend to major in engineering or the sciences at University of New Hampshire, or at another college or university, then it is likely that you will encounter Logger Pro™ again.

Installing LoggerPro™

Here are links to download the software you requested from Vernier Software & Technology. Go to the URL shown below - the download should start automatically. After the file has downloaded to your computer, double-click the file, and enter the password to install the software.

Windows 7, 8, 10
Logger Pro 3.10 with sample movies (Windows)
http://www.vernier.com/d/yt2gg

Password: conservation

Mac OS X 10.11, 10.10, 10.9, 10.8
Logger Pro 3.10 with sample movies (Mac OS X)
http://www.vernier.com/d/54u9c

Password: conservation

Detailed Instructions
For more details on how to download and install Logger Pro, see:
http://www.vernier.com/til/2069/

Please to not call Vernier with questions about the tutorials or labs. Instead, get help from me or a classmate.

Using LoggerPro™

1. Start Logger Pro™.
2. Select **File-Open-Tutorials** from the menu bar. A list of tutorials will appear.
3. Open and complete these tutorials:

- ☐ *01 Getting Started*
- ☐ *05 Manual Data Entry*
- ☐ *06 Customization*
- ☐ *07 Viewing Graphs*
- ☐ *08 Stats, Tangents, Integral*
- ☐ *09 Curve Fitting*
- ☐ *10-1 Linearization*
- ☐ *10-2 Linearization*
- ☐ *10-3 Linearization*

Problem Set
The Metric System, Units and Significant Digits[1]

Question type: MC = Multiple Choice Question, CQ = Conceptual Question, IE = Integrated Exercise.

Difficulty: ● = Easy; ●● = Moderate; ●●●=Challenging

1.2 SI Units of Length, Mass, and Time

1. How many base units are there in the SI: (a) 3, (b) 5, (c) 7, or (d) 9?
2. The only SI standard represented by material standard is the (a) meter, (b) kilogram, (c) second, (d) electric charge.
3. Which of the following is *not* an SI base quantity: (a) mass; (b) weight; (c) length; or (d) time?
4. Which of the following is the SI base unit for mass: (a) pound; (b) gram; (c) kilogram; (d) ton?
6. Why is weight not a base quantity?

1.3 More about the Metric System

9. The prefix *giga-* means (a) 10^{-9}, (b) 10^{9}, (c) 10^{-6}, (d) 10^{6}.
10. The prefix *micro-* means (a) 10^{6}, (b) 10^{-6}, (c) 10^{3}, (d) 10^{-3}.
12. One liter of water has a volume of (a) 1 m^3, (b) 1 qt, (c) 1000 cm^3, (d) 10^4 mm^3.
13. If a fellow student tells you he saw a 3-cm-long ladybug, would you believe him? How about another student saying she caught a 10-kg salmon? Explain your reasoning.
14. Show that 1 mL is equivalent to 1 cm^3.
18. ●● A sailor tells you that if his ship is traveling at 25 knots (nautical miles per hour), it is moving faster than the 25 mi/hr your car travels. How can that be?

1.4 Unit Analysis

19. Both sides of an equation are equal in (a) numerical value, (b) units, (c) dimensions, (d) all of the preceding.
20. Unit analysis of an equation cannot tell you if (a) the equation is dimensionally correct, (b) the equation is physically correct, (c) the numerical value is correct, (d) both b and c.
23. The equation for the area of a circle from two sources is given as $A = \pi r^2$ and $A = \pi d^2/2$. Can unit analysis tell you which is correct? Explain.
25. ● Show that the equation $x = x_0 + vt$ is dimensionally correct, where v is velocity and x and x_0 are lengths, and t is time.
26. ● If x refers to distance, v_0 and v to speeds, a to acceleration, and t to time, which of the following equations is dimensionally correct:
(a) $x = v_0 t + at^3$; (b) $v^2 = v_0^2 + 2at$; (c) $x = at + vt^2$; or (d) $v^2 = v_0^2 + 2ax$?
28. ●● A friend tells you that the volume of a sphere is given by $V = \pi d^3/4$, where V is the volume and d is the diameter of the sphere. Is this equation dimensionally correct? Show your work.
29. ●● A correct equation for the volume of a sphere is $V = 4\pi r^3/3$, where r is the radius of the sphere. Is the equation in Exercise 28 also correct? If not, what is the correct equation expressed in terms of d? Show your work.
30. ●● The kinetic energy (E_k) of an object of mass m moving with speed v is given by $E_k = \frac{1}{2}mv^2$. The name for the unit of kinetic energy in the SI system is the joule (J). What are the units of the joule

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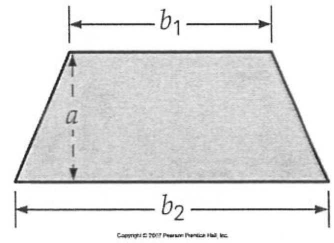
in terms of SI base units? Show your work.

31. ●● The general equation for a parabola is $y = ax^2 + bx + c$, where a, b, and c are constants. What are the units of each constant if y and x are in meters? If there are no units, say so.

32. ●● The units for pressure (p) in terms of SI base units are known to be $\frac{\text{kg}}{\text{m} \cdot \text{s}^2}$. For a physics class assignment, a student derives an expression for the pressure exerted by the wind on a wall in terms of the air density (ρ) and wind speed (v) and her result is $p = \rho v^2$. Show that her result is dimensionally consistent. Does this prove that this relationship is physically correct?



34. ●● Is the equation for the area of a trapezoid, $A = \frac{1}{2}a(b_1 + b_2)$, where a is the height and b_1 and b_2 are the bases, dimensionally correct? Show your work.

35. ●● Bill, a physics student, does some unit analysis and concludes that the equation $v = \sqrt{2ax}$ is dimensionally correct. Jill, his lab partner, says it isn't. With whom do you agree, and why?

36. ●●● Newton's second law of motion (Chapter 4) is expressed by the equation $F = ma$, where F represents force, m is mass, and a is acceleration.
(a) The SI unit of force is, appropriately, called the "newton" (N). What are the units of the newton in terms of base quantities? Show your work.
(b) An equation for force associated with uniform circular motion (Chapter 7) is $F = mv^2/r$, where v is speed and r is the radius of the circular path. Does this equation give the same units for the newton? Show your work.

38. ●●● Einstein's famous mass–energy equivalence is expressed by the equation $E_0 = mc^2$, where E is energy, m is mass, and c is the speed of light.
(a) What are the SI base units of energy?
(b) Another equation for energy is $E = mgh$, where m is mass, g is the acceleration due to gravity, and h is height. Does this equation give the same units as in part (a)?

1.5 Unit Conversions

39. The best way to ensure proper unit conversion is to (a) use another measurement instrument, (b) always work in the same system of units, (c) use unit analysis, (d) have someone check your math.

40. You often see 1 kg = 2.2 lbs. This expression means that (a) 1 kg is <u>equivalent</u> to 2.2 lb, (b) this is a true <u>equation</u>, (c) 1 lb = 2.2 kg, (d) none of the preceding.

41. You have a quantity of water and wish to express this in volume units that give the largest number. Should you use (a) in^3, (b) mL; (c) μL, or (d) cm^3

42. Are an equation and an equivalence statement the same? Explain.

43. Does it make any difference whether you multiply or divide by a conversion factor? Explain.

44. Does unit analysis apply to unit conversions? Explain.

46. ● (a) If you wanted to express your height with the largest number, would you use meters, feet, inches, or centimeters. Why?
(b) If you are 6.00 ft tall, what is your height in centimeters?

47. ● If the capillaries of an average adult were unwound and spread out end to end, they would extend to a length over 40,000 mi. If you are 1.75 m tall, how many times your height would the capillary length equal?

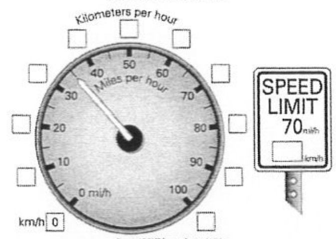
48. ● Compared with a 2-L soda bottle, a half-gallon soda bottle holds (1) more, (2) the same amount of, (3) less soda. Verify your answer.

49. ● (a) A football field is 300 ft long and 160 ft wide. What are the field's dimensions in meters?
(b) A football is 11.0 to 11.25 in. long. What is its length in centimeters?

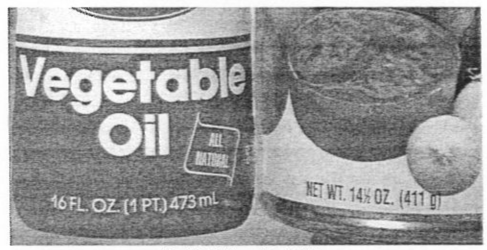
53. **IE** ●● (a) Which of the following represents the greatest speed: (1) 1 m/s, (2) 1 km/hr, (3) 1 ft/s, or (4) 1 mi/hr
(b) Express the speed15.0 m/s in mi/hr

54. ●● An automobile speedometer is shown.
(a) In each empty box record the equivalent speed in kilometers per hour.
(b) What would be the 70 mi/hr speed limit in kilometers per hour? Record it on the sign.

Figure 1-16
Speedometer readings



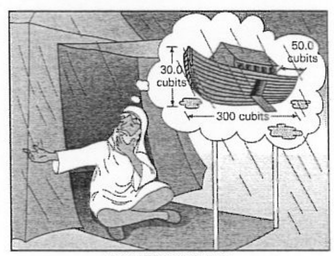
55. ●● A person weighs 170 lb.
(a) What is her mass in kilograms?
(b) Assuming the density of the average human body is about that of water (which is true), estimate her body's volume in both cubic meters and liters. Explain why the smaller unit of the liter is more appropriate (convenient) for describing this size volume.



59. ●● Some common product labels are shown. From the units on the labels, find:
(a) the number of milliliters in 2 fl. oz and
(b) the number of ounces in 100 g.

61. ●●● A student was 18 in. long when she was born. She is now 5 ft 6 in. tall and 20 years old. How many centimeters a year did she grow on average?

64. ●●● In the Bible, Noah is instructed to build an ark 300 cubits long, 50.0 cubits wide, and 30.0 cubits high. Historical records indicate a cubit is equal to half a yard.
(a) What would the dimensions of the ark be in meters?
(b) What would the ark's volume be in cubic meters? To approximate, assume that the ark is to be rectangular, like a barge.



1.6 Significant Figures

66. Which of the following numbers has four significant figures: (a) 140.05; (b) 276.02; (c) 0.004006; or (d) 0.073004 ?

67. In a multiplication and/or division operation involving the numbers 15,436, 201.08, and 408.0×10^5 the result should have how many significant figures? (a) 3 (b) 4 (c) 5 (d) any number

68. What is the purpose of significant figures?

70. How are the number of significant figures determined for the results of calculations involving
(a) multiplication (c) addition
(b) division (d) subtraction?

71. ● Express the length 50,500 μm (micrometers) in centimeters and meters, to three significant figures.

73. ● Determine the number of significant figures in the following measured numbers:
(a) 1.007 m; (c) 16.272 kg;
(b) 8.03 cm; (d) 0.015 μs;

74. ● Express each of these numbers with two significant figures.
(a) 1.007 m; (c) 16.272 kg;
(b) 8.03 cm; (d) 0.015 μs;

75. ● Which of the following quantities has three significant figures: (a) 305.0 cm; (b) 0.0500 mm; (c) 1.000 81 kg; or (d) 8.06 x 10^4 m^2

76. ●● The cover of your physics book measures 0.274 m long and 0.222 m wide. What is its area in square meters? Use proper sig figs.

77. ●● The interior storage compartment of a restaurant refrigerator measures 1.3 m high, 1.05 m wide, and 67 cm deep. Determine its volume in cubic feet. Use proper sig figs.

80. ●● Express the following calculations to the proper number of significant figures:

(a) 12.634+2.1

(b) 13.5-2.134

(c) $\pi(0.25\text{ m})^2$

(d) $\sqrt{2.37/3.5}$.

81. ●●● In doing a problem, a student adds 46.9 m and 5.72 m and then subtracts 38 m from the result.

(a) How many decimal places will the final answer have: (1) zero; (2) one; or (3) two? Why?

(b) What is the final answer?

82. ●●● Work this exercise by the two given procedures stated below, commenting on and explaining any difference in the answers. Use your calculator for the calculations. Compute $p = mv$, where $v = x/t$, given x = 8.5 m, t =2.7 s and m = 0.66 kg

(a) First compute v and then p.

(b) Compute $p = mx/t$ without an intermediate step. (c) Are the results the same? If not, why?

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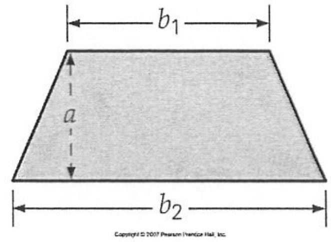

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